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(54) **STAGED USER ENROLLMENT USING AUDIO DEVICES**

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G10L 15/22 (2006.01)
H04L 9/08 (2006.01)

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CPC ***G10L 15/30*** (2013.01); ***G10L 15/22*** (2013.01); ***H04L 9/088*** (2013.01)

(58) **Field of Classification Search**
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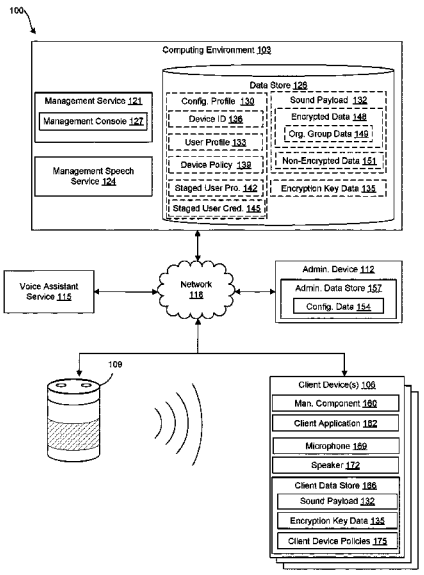
(57) **ABSTRACT**

Disclosed are various embodiments for staged user enrollment using audio devices. In one embodiment, among others, a system includes a computing device and program instructions. The program instructions can cause the computing device to receive a configuration profile for configuring a client device. The configuration profile includes a device policy associated with an organizational group. The program instructions can further cause the computing device to generate a sound payload based on encoding the configuration profile onto a sound signal. A request is received a request from a voice assistant service for configuring the client device. The request is associated with configuring the client device according to the device policy. The sound payload is transmitted to the voice service for broadcasting from a speaker device. The sound payload is broadcast within an audible distance of the client device.

20 Claims, 4 Drawing Sheets



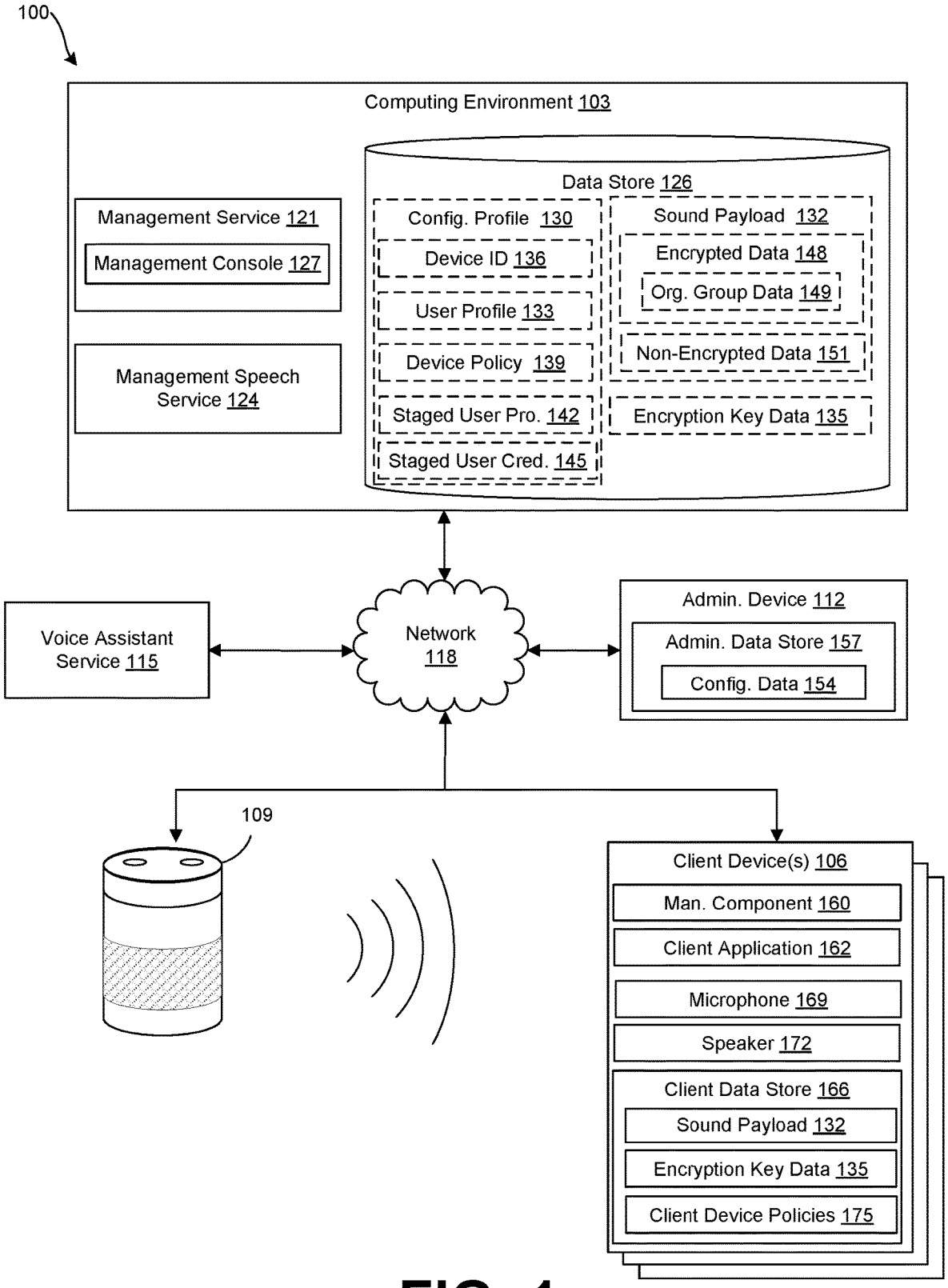

100
Computing Environment 103
Data Store 126
Management Service 121
Management Console 127
Management Speech Service 124
Config. Profile 130
Device ID 136
User Profile 133
Device Policy 139
Staged User Pro. 142
Staged User Cred. 145
Sound Payload 132
Encrypted Data 148
Org. Group Data 149
Non-Encrypted Data 151
Encryption Key Data 135
Voice Assistant Service 115
Network 118
Admin. Device 112
Admin. Data Store 157
Config. Data 154
109
Client Device(s) 106
Man. Component 160
Client Application 162
Microphone 169
Speaker 172
Client Data Store 166
Sound Payload 132
Encryption Key Data 135
Client Device Policies 175

FIG. 1

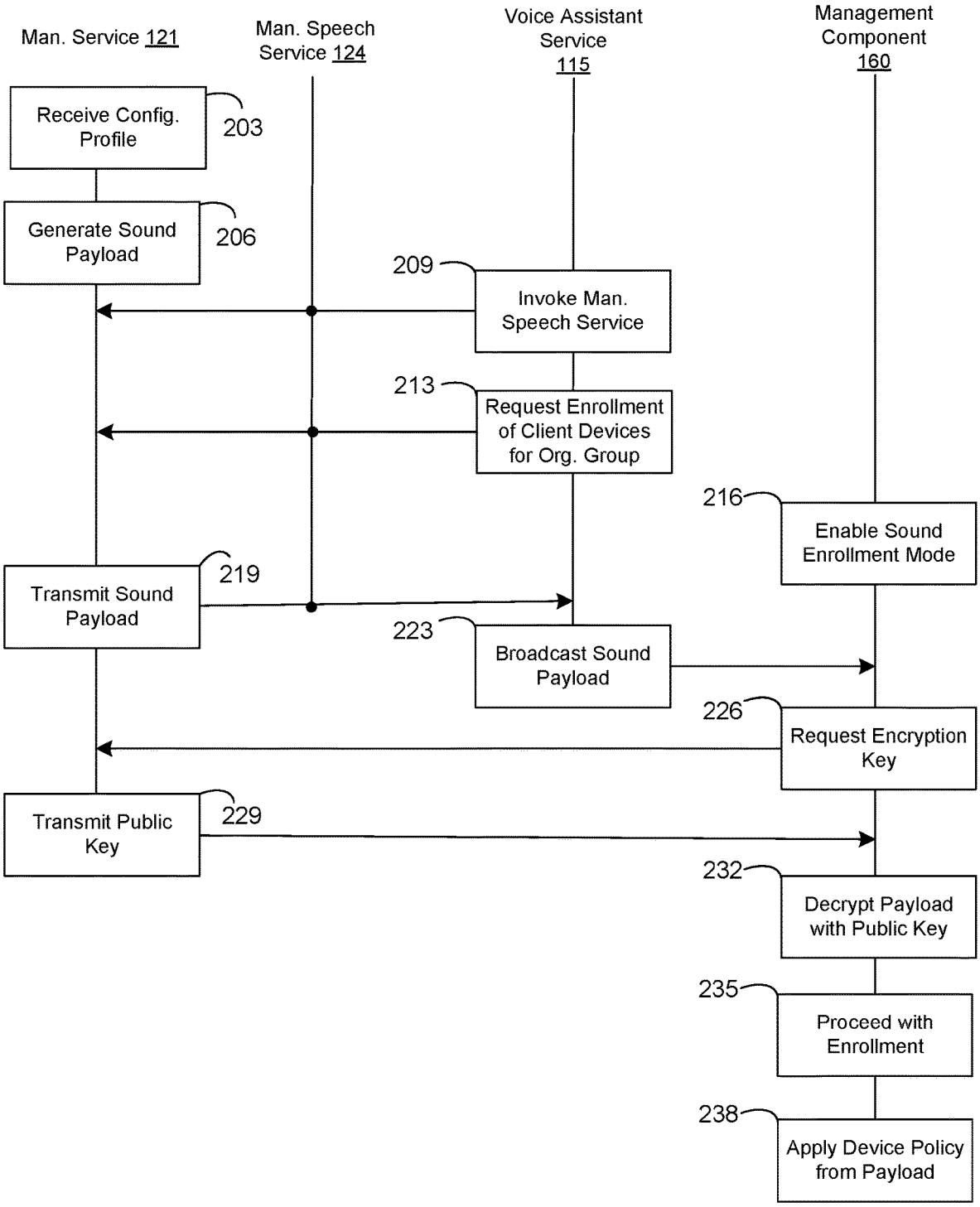

Man. Service 121
Man. Speech Service 124
Voice Assistant Service 115
Management Component 160
Receive Config. Profile
203
Generate Sound Payload
206
209
Invoke Man. Speech Service
213
Request Enrollment of Client Devices for Org. Group
216
Enable Sound Enrollment Mode
Transmit Sound Payload
219
223
Broadcast Sound Payload
226
Request Encryption Key
Transmit Public Key
229
232
Decrypt Payload with Public Key
235
Proceed with Enrollment
238
Apply Device Policy from Payload

FIG. 2

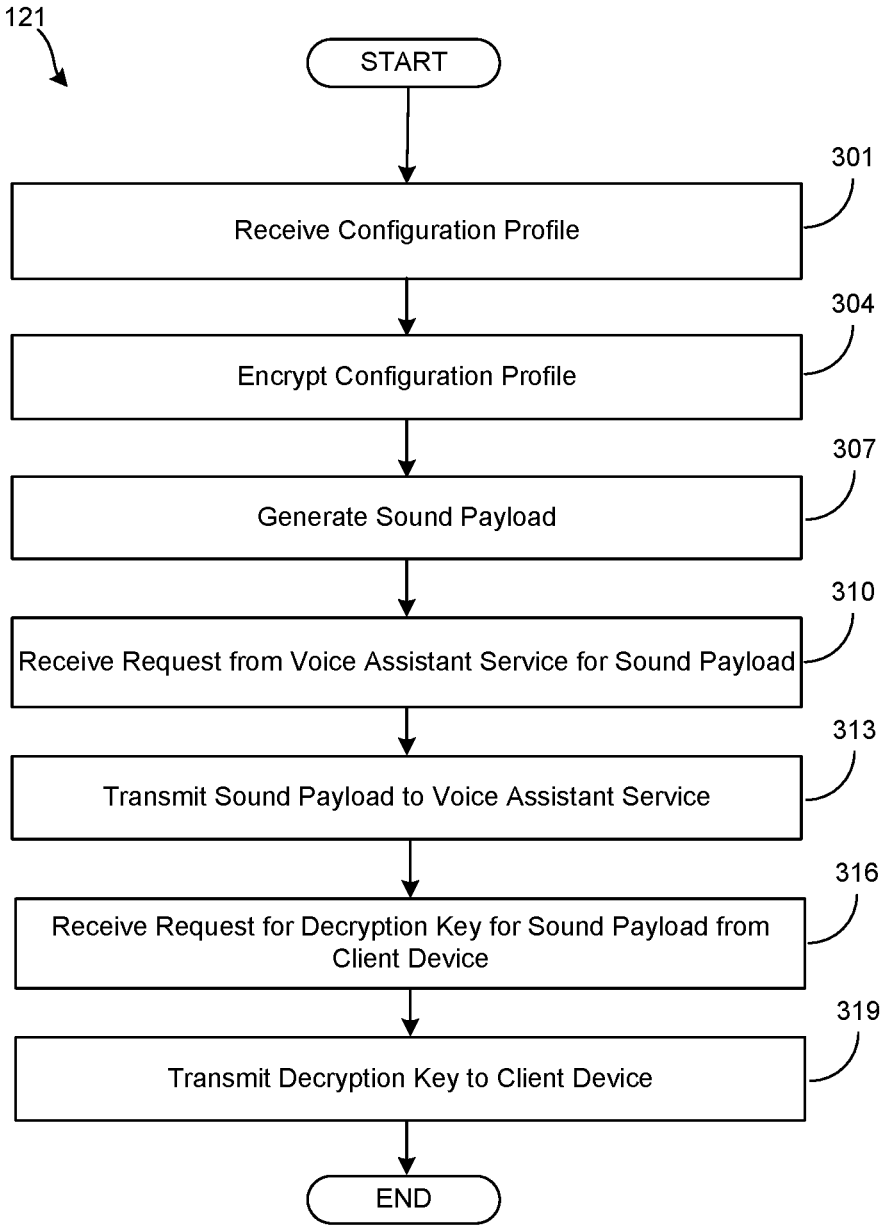

121
START
301
Receive Configuration Profile
304
Encrypt Configuration Profile
307
Generate Sound Payload
310
Receive Request from Voice Assistant Service for Sound Payload
313
Transmit Sound Payload to Voice Assistant Service
316
Receive Request for Decryption Key for Sound Payload from Client Device
319
Transmit Decryption Key to Client Device
END

FIG. 3

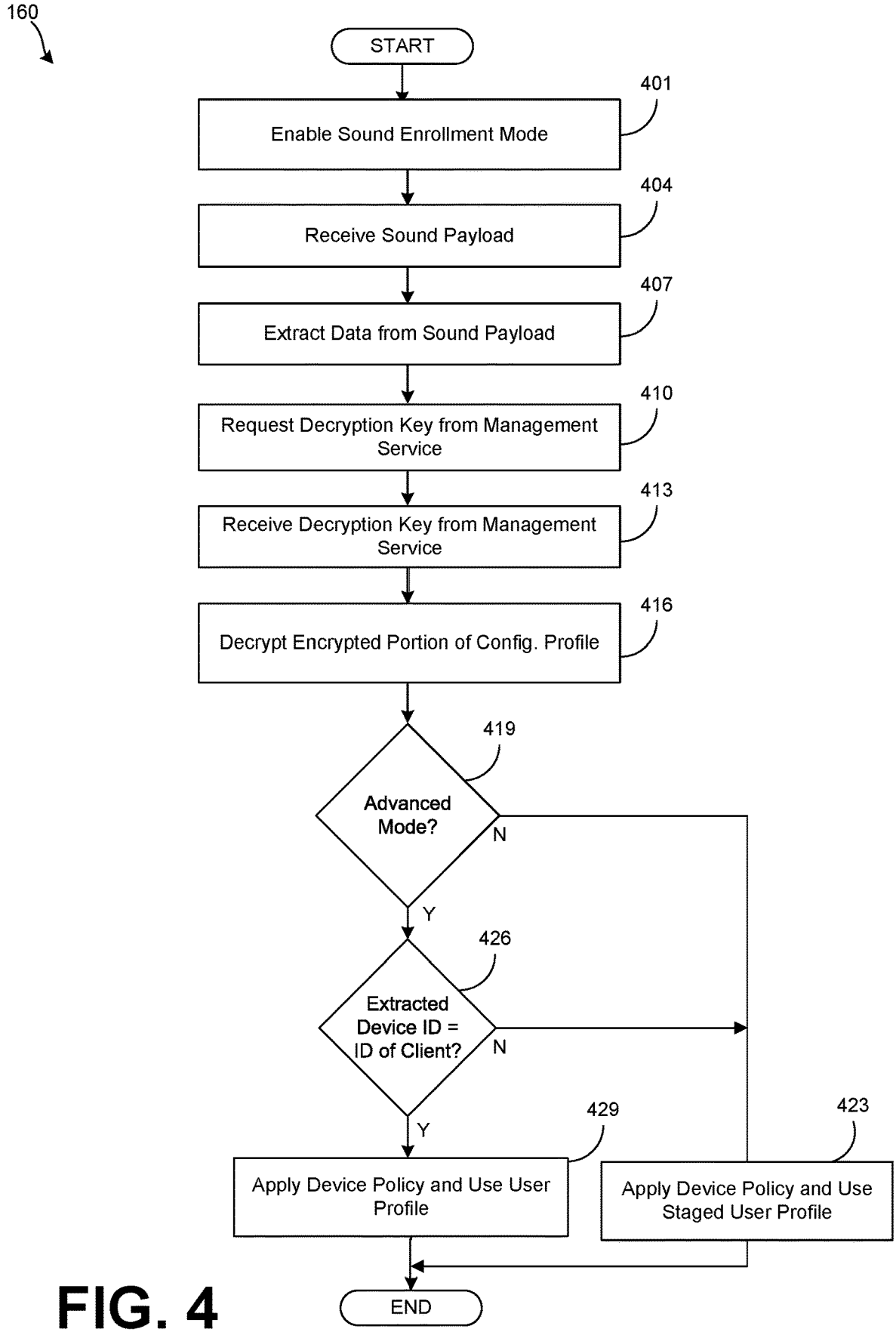

160
START
401
Enable Sound Enrollment Mode
404
Receive Sound Payload
407
Extract Data from Sound Payload
410
Request Decryption Key from Management Service
413
Receive Decryption Key from Management Service
416
Decrypt Encrypted Portion of Config. Profile
419
Advanced Mode?
N
Y
426
Extracted Device ID = ID of Client?
N
Y
429
Apply Device Policy and Use User Profile
423
Apply Device Policy and Use Staged User Profile
END

FIG. 4

STAGED USER ENROLLMENT USING AUDIO DEVICES

BACKGROUND

Organizations and enterprises often purchase computing devices for use by their employees. Such computing devices can be preconfigured by the seller. However, further configuration is sometimes desired by the organization or enterprise or by individual members of the organization or enterprise using the computing device. For example, organizations or enterprises may wish to install management applications to regulate the data accessible on purchased computing devices or the applications installed on the purchased computing devices.

Management applications can often begin managing a purchased computing device as soon as they are installed. For example, the management application may begin attempting to install applications or limit access to files for the user that installed the management application. However, in some cases, the installation of a management application can require an information technology (IT) worker to manually install and configure its settings under an administrator account, which can be time-consuming for a batch of devices.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the present disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, with emphasis instead being placed upon clearly illustrating the principles of the disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a schematic block diagram depicting an example of a network environment according to examples of the disclosure.

FIG. **2** is an example sequence diagram illustrating functionality implemented by components of the networked environment in FIG. **1**.

FIG. **3** is a flow chart depicting the operation of an example of a component of the network environment of FIG. **1**.

FIG. **4** is a flow chart depicting the operation of an example of a component of the network environment of FIG. **1**.

DETAILED DESCRIPTION

The present disclosure includes examples related to staging managed devices with a sound signal. A user, such as an administrative user or an information technology (IT) support worker, can install a management component on a device and select a set of policies to be enforced on the device. For instance, policies enforced by the management component can control use of the device, installation of applications on the device, or content accessible on or by the device, as well as other functionality of the device. An organization or enterprise can regulate which policies to enforce for a device based on the end user's occupational role and/or the end user's association with an organizational group within the organization or enterprise.

To install a management component, an administrative user can login to the device using a staging profile. In the context of the present disclosure, a device can be a mobile phone, a laptop, a tablet, a personal computer, a wearable

device, a speaker device, and other computing devices. The staging profile can be a profile configured not to cause user specific policies to be enforced on the device. In some examples, a later user will logon to the device and a management system can associate the corresponding user profile with the device and can cause any policies linked to the user profile of the later user to be applied to the device and enforced by the management component installed on the device. With this approach, the administrator has to manually enroll and configure the management component of every device with the management system. The enrollment process can vary for different operating systems executed on the devices and/or for different device manufacturers. Accordingly, enrolling multiple devices to be managed by the management system can be time-consuming.

The present disclosure includes various examples related to enrolling multiple devices concurrently with a sound wave signal. For example, an administrator user can position multiple devices within an audible range of a speaker device, such as a smart speaker, a voice assistant device, or other suitable speaker devices. The devices can be configured to operate in a sound enrollment mode, which can prepare the devices to receive the sound wave. The speaker device can broadcast the sound wave for the devices. The sound wave can have embedded data that the device can use to automate an enrollment process with a management system. In some examples, voice assistant devices can be used to initiate and control a playback of the sound wave.

Beginning with FIG. **1**, shown is an example of a networked environment **100**. The networked environment **100** includes a computing environment **103**, a client device **106**, a voice assistant device **109**, an administrative device **112**, and a voice assistance service **115**, which are in data communication with each other across a network **118**. The network **118** includes wide area networks (WANs) and local area networks (LANs). These networks can include wired or wireless components or a combination thereof. Wired networks can include Ethernet networks, cable networks, fiber optic networks, and telephone networks, such as dial-up, digital subscriber line (DSL), and integrated services digital network (ISDN) networks. Wireless networks can include cellular networks, satellite networks, Institute of Electrical and Electronic Engineers (IEEE) 802.11 wireless networks (e.g., WI-FI®), BLUETOOTH® networks, microwave transmission networks, as well as other networks relying on radio broadcasts. The network **118** can also include a combination of two or more networks **118**. Examples of networks **118** can include the Internet, intranets, extranets, virtual private networks (VPNs), and similar networks.

The computing environment **103** can include, for example, a server computer or any other system providing computing capability. Alternatively, the computing environment **103** can employ a plurality of computing devices that can be arranged, for example, in one or more server banks or computer banks or other arrangements. These computing devices can be located in a single installation or can be distributed among many different geographical locations. For example, the computing environment **103** can include a plurality of computing devices that together can include a hosted computing resource, a grid computing resource or any other distributed computing arrangement. In some cases, the computing environment **103** can correspond to an elastic computing resource where the allotted capacity of processing, network, storage, or other computing-related resources can vary over time.

The components executed on the computing environment **103** can include a management service **121**, a management

speech service **124**, and other applications, services, processes, systems, engines, or functionality not discussed in detail herein. The management service **121** is executed in the computing environment **103** to monitor and manage the operation of one or more client devices **106**. The management service **121** can regulate data accesses locally on the client device **106** and access to networked resources associated with the computing environment. Additionally, the management service **121** can regulate the use of device resources and the application functionality executed on the client device.

The management speech service **124** can be executed to manage enterprise data and voice driven-applications. The management speech service **124** can interface with a voice assistant service **115**. The computing environment **103** also includes a data store **126**. The data stored in the data store **126** can include one or more configuration profiles **130**, one or more sound payloads **132**, encryption key data **135**, and potentially other data.

In some examples, the management service **121** can include a management console **127**, which facilitates the management of client devices **106** by administrators. For instance, the management console **127** generates user interfaces that are rendered on a display device to facilitate administrators operating and interacting with the management service **121**. Such user interfaces facilitate an administrator inputting commands or other information for the management service **121**. The commands can include specifying a configuration profile **130** for one or more client devices **106** to be managed by the management service **121**. The commands can include specifying one or more user profiles **133** for one or more client devices **106**. The information can include data, applications, or application functionality that is to be accessible or inaccessible for a specified user profile **133**. The user interfaces also include, for example, presentations of statistics or other information regarding the client devices **106** that are managed by the management service **121**.

Configuration profiles **130** can represent data specified by an administrator for configuring one or more client devices **106** to be managed by the management service **121**. In one example, a configuration profile **130** can include a device identifier **136** associated with a particular client device **106**, a user profile **133** that corresponds to an end-user, a device policy **139**, a staged user profile **142**, staged user credentials **145**, and other suitable configuration data for enrolling a device to be managed.

User profiles **133** can represent network user accounts which a user can use to login to the client device **106** and/or the management service **121**. Each user profile **133** can have a unique user identifier among other end-users associated with the management service **121**. The device identifier **136** can represent a unique device identifier among other client devices **106** being managed by the management service **121**. In other examples, the device identifier **136** can represent a device serial number or other suitable device identifiers. The configuration profile **130** can include mapping data that maps device identifiers **136** to a user profile **133**.

A device policy **139** can specify how a client device **106** associated with the device policy **139** is to be managed. The device policy **139** can also represent a collection of settings for a particular client device **106** related to accessible and inaccessible device resources, data, application functionality, and other suitable access controls. For instance, a device policy **139** can specify which resources the management service **121** is permitted to provide to a client device **106**. As an example, a device policy **139** can specify whether the management service **121** is to provide an email service or a calendar service to a client device **106**. In other instances, the device policy **139** can specify which features of an email service are accessible to the client device **106**. In other examples, the device policy **139** can specific which device resources the client device **106** can access. For instance, the device policy **139** can prohibit the use of a camera, a microphone, or wireless communication transceivers on the client device **106**. In other implementations, the device policy **139** can restrict the access to data or functionality of a third-party application.

In some examples, a device policy **139** can be assigned to a particular client device **106** intended for an end-user. The assigned device policy **139** can be based on the end-user being associated with a particular organizational group. For example, a particular organizational group can have certain security concerns within an enterprise. For instance, employees with access to confidential data can have a particular device policy **139** enforced on their client device **106** in order to address security concerns. The staged user profile **142** can represent a user account of an administrator or an information technology (IT) worker that is configuring client devices **106**. The staged user credential **145** can represent a password, an authentication token, and other suitable authentication credentials.

The sound payload **132** can represent configuration profile **130** data embedded into a sound wave. The sound payload **132** can be perceivable or unperceivable by humans. Upon receiving the sound wave, the client device **106** can extract the configuration profile **130** data from the sound wave and process the configuration profile **130** data in order to enroll or configure the client device **106** to be managed by the management service **121**. In some examples, the sound payload **132** can include encrypted data **148** and non-encrypted data **151**. The encrypted data **148** of the sound payload **132** can include the staged user profile **142** and the staged user credentials **145** of an administrator user. The encrypted data **148** can also include organizational group data **149**, such as an organizational group identifier and other organizational group data.

The organizational group data **149** can refer to different organizational groups within an enterprise or an entity. Each organizational group can have a group of client devices **106** managed by the management service **121**. In some examples, at least some of the organizational groups can correspond to an enterprise's internal hierarchy or business structure. For example, an enterprise can have an engineering team, an accounting team, and a marketing team. A first organizational group can include members of the engineering team. A second organizational group can include members of the accounting team, and a third organizational group can include members of the marketing team. Each organizational group can have a different device policy **139** for its members based on the organizational group's role within enterprise and security concerns.

The non-encrypted data **151** can include a uniform resource location (URL) for the management service **121** or other configuration data for enrolling a device to be managed. The encryption key data **135** can relate to public key and private key pairs for encrypting and decrypting data embedded into the sound payload **132**. The key pairs can represent an asymmetric cryptographic key pair that can include a public encryption key and a corresponding private encryption key. For example, the key pairs can correspond to a key pair for the Rivest, Shamir and Adleman (RSA) algorithm, the Elgamal encryption algorithm, or various elliptic curve cryptographic (ECC) algorithms. The key

pairs can be used to secure transfer of the configuration profile **130** data through the sound payload **132**.

In some examples, the key pair can be generated and used for secure transfer of encrypted data **148** for different sound payloads **132**. In other examples, a different key pair can be generated for each sound payload **132**. This approach ensures that if a key pair is stolen or otherwise compromised, subsequent sound payloads **132** will not be at risk. The organizational group data **149** can be used to indicate a particular organizational group associated with the end user of the client device **106**. An enterprise may determine that the client devices **106** associated with the particular organizational group can call for the enforcement of a certain device policy **139**.

The administrative device **112** can represent one or more administrative devices **112** in data communication with other devices in the networked environment **100**. The administrative device **112** can be operated by an administrative user that transmits configuration data **154** to the computing environment **103**. The administrative device **112** can include, for example, a processor-based system such as a computer system. Examples of these computer systems can include a personal computer (e.g., a desktop computer, a laptop computer, or similar device), a mobile computing device (e.g., personal digital assistants, cellular telephones, smartphones, web pads, tablet computer systems, music players, portable game consoles, electronic book readers, and similar devices), or other devices with like capability. The administrative device **112** can include one or more displays, such as liquid crystal displays (LCDs), gas plasma-based flat panel displays, organic light emitting diode (OLED) displays, electrophoretic ink ("E-ink") displays, projectors, or other types of display devices. In some instances, the display can be a component of the administrative device **112** or can be connected to the administrative device **112** through a wired or wireless connection. The administrative device **112** can include an administrative data store **157**, which stores the configuration data **154**. The configuration data **154** can represent data for configuring one or more client devices **106** though a sound wave. The configuration data **154** can be embedded into a sound wave by the management service **121** and/or the management speech service **124**. In some examples, an administrative device **112** can render a user interface of the management console **127** for an administrative user. The user interface can allow the administrative user to enter configuration data **154** manually or automatically from the administrative data store **157**.

The client device **106** is representative of a plurality of client devices **106** that can be coupled to the network **118**. The client device **106** can include, for example, a processor-based system such as a computer system. Examples of these computer systems can include a personal computer (e.g., a desktop computer, a laptop computer, or similar device), a mobile computing device (e.g., personal digital assistants, cellular telephones, smartphones, web pads, tablet computer systems, music players, portable game consoles, electronic book readers, and similar devices), or other devices with like capability. The client device **106** can include one or more displays, such as liquid crystal displays (LCDs), gas plasma-based flat panel displays, organic light emitting diode (OLED) displays, electrophoretic ink ("E-ink") displays, projectors, or other types of display devices. In some instances, the display can be a component of the client device **106** or can be connected to the client device **106** through a wired or wireless connection.

The client device **106** can be configured to execute various applications such a management component **160** and a client application **162**. The client device **106** can also include a client data store **166**, a microphone **169**, and a speaker **172**. The client application **162** can cause a user interface to be rendered on a display. The client data store **166** can store the sound payload data **132**, encryption key data **135**, and client device policies **175**. The client device policies **175** can represent one or more device policies **139** that have been received from sound payloads **132**.

The management component **160** can be executed in the client device **106**, for example, to monitor and manage data, software components, and hardware components with respect to the client device **106**. The management component **160** can communicate with the management service **121** to facilitate the management service **121** in monitoring and managing the client device **106**. For example, the management component **160** transmits data that indicates the status of properties and settings for the client device **106**, as well as one or more client device policies **175** currently applied to the client device **106** or the current user of the client device **106**. The management component **160** can apply and/or enforce one or more client device policies **175**. In one example, the management component **160** functions as a device management service that operates as a portion of an operating system for the client device **106**. In another example, the management component **160** functions as a device management agent that operates in the application layer of the client device **106**. The management component **160**, in other examples, can include an application wrapper that interfaces with a software component to facilitate overseeing, monitoring, and managing resources for the client device **106**. In alternative examples, the management component **160** includes a portion of an application that was developed, for example, using a Software Development Kit (SDK) so that the monitoring and management functionality is provided using the application.

The client application **162** can represent various applications and software programs executed on the client device **106**, such as a web browser, and an operating system. In one non-limiting example, the client application **162** facilitates user authentication with the voice assistant service **115** so that a user can create an association between a voice assistant device **109**, such as a smart speaker. To this end, the microphone **169**, the speaker **172** and other suitable device resources can facilitate communication with a voice assistant device **109**.

The voice assistant device **109** can represent one or more devices equipped with a speaker **172** and a microphone **169**. The voice assistant device **109** allows for audio playback to provide a voice assistant experience. A voice assistant experience can represent an experience in which a user can provide spoken commands or requests that are captured by the one or more microphones **169** integrated with or in communication with the voice assistant device **109**. The voice assistant device **109** can playback audio using the speaker **172** in response to the spoken commands or requests. For example, an administrative user can ask the voice assistant device **109** to invoke the management speech service **124** for initiating an enrollment process for one or more client devices **106**. In another example, an administrative user can ask the voice assistant device **109** to initiate the management speech service **124** for enabling access to restrictive applications and secure data stored in the data store **126** of an enterprise.

In some embodiments, the voice assistant device **109** can include a display for rendering user interfaces and video. In

these scenarios, the voice assistant device **109** can render a video file that broadcasts the sound payload **132** during playback of the video file.

The voice assistant service **115** can communicate with the voice assistant device **109** to process voice commands and facilitate retrieval of information for playback through the voice assistant device **109**. The voice assistant service **115** can perform voice recognition or speech-to-text conversion on audio captured by the voice assistant device **109**, identify a command or action to perform in response to the captured audio, and response to the voice assistant device **109** audio that should be played back through the voice assistant device **109**. The voice assistant service **115** can also provide an API so that third parties can create applications or extend the capabilities of the voice assistant device **109**. These applications or capabilities can be implemented within a cloud-based voice assistant service **115** so that the functionality does not need to be implemented within every voice assistant device **109** that is deployed in order for extended capabilities to be available to every user.

Next, a general description of the operation of the various components of the networked environment **100** is provided. To begin, an administrative user can use their administrative device **112** to login into the management console **127**. The administrative user can provide their staged user profile **142** and staged user credentials **145** in order to login into the management console **127**. The administrative device **112** can render user interfaces for the management console **127** in order to enable the administrative user to specify a configuration profile **130** by manually selecting profile settings or by uploading configuration data **154** from the administrative device **112**. The configuration profile **130** can be used for authorizing a sound payload **132** to be generated for one or more client devices **106**. The configuration profile **130** can store data such as the staged user profile **142** and the staged user credentials **145**. The configuration profile **130** can also store the device identifiers **136** of the client devices **106** that are going to be managed by the management service **121**. The configuration profile **130** can include a mapping of the device identifiers **136** to user profiles **133** of the end-users. For example, a batch of ten mobile phones can be purchased in bulk, where each mobile phone has a unique device identifier **136**. Each mobile phone can be intended for an end-user with a unique user profile **133**. The configuration profile **130** can also include organizational group data **149**, such as an organizational group identifier, for an organizational group associated with the end-user. The organizational group identifier can be associated with a particular device policy **139**. The management service **121** can monitor the enforcement of the particular device policy **139** on the client devices **106** associated with a particular organizational group.

The sound payload **132** can be generated based on the configuration profile **130**. The sound payload **132** can be generated by embedding the configuration profile **130** onto a sound wave using steganography. Steganography can refer to various techniques for concealing data within a sound wave file or a video file. For example, audio steganography techniques can include low-bit encoding, phase coding, spread spectrum, echo data hiding, and other suit techniques for concealing data within in an audio or video file.

The sound payload **132** can be generated to include encrypted data **148** and non-encrypted data **151**. For example, the organizational group data **149**, the staged user profile **142**, and the staged user credentials **145** can be encrypted. In this example, the non-encrypted data **151** can include a server identifier for the management service **121**, such as an internet address, a uniform resource locator (URL) address, or other suitable methods for identifying the management service **121** on the network **118**.

Additionally, the management component **160** can be installed on the client devices **106**, and the management component **160** can be configured in a sound mode in preparation for receiving the sound payload **132**. While in sound mode, the client devices **106** can be positioned with in a range of the voice assistance device **109** such that the client device **106** can audibly detect and record the sound payload **132**.

An administrative user can then engage a voice assistant device **109** to begin playback of the sound payload **132**. Initially, the administrative user can use the voice assistant device **109** to login into the management speech service **124**. For example, the administrative user can verbally provide their staged user profile **142** and staged user credentials **145** in order to authenticate a session with the management speech service **124** through the voice assistance service **115**. In other examples, the administrative device **112** can be in data communication with the voice assistance device **109** after a wireless pairing process has been completed. The administrative user can then link an authenticated session associated with the staged user profile **142** to the voice assistant device **109**.

The administrative user can use the voice assistant service **115** to invoke functions and/or features associated with the management speech service **124** through one or more keywords spoken by the administrative user. For example, the administrative user can speak "Assistant, open management workspace." The keywords "management workspace," or any other keyword, can be associated with the management speech service **124**. Then, the administrative user can invoke particular functions and/or features of the management speech service **124**. For example, the administrative user can speak "Assistant, enroll devices to organizational group alpha beta." The keywords "enroll device," or any other keywords, can be associated with initialing an execution of an enrollment process of one or more client devices **106** with use of a sound payload **132**. The keywords "organizational group alpha beta," or any other keywords can be used to identify the sound payload **132** associated with organizational group "alpha beta." These commands and parameters can be transmitted to the management speech service **124**.

In response, the management speech service **124** can transmit the sound payload **132** to the voice assistant service **115**, which is in turn transmitted to the voice assistant device **109**. The voice assistant device **109** can broadcast the sound payload **132** to the client devices **106** in the vicinity. The client devices **106** can detect and record the sound payload **132** and extract data related to setting up the client device **106** to be managed by the management service **121**. Through the extraction process, the client device **106** can obtain a client device policy **175**, which can be used to enforce restrictions related to device resources, application functionality, data access, and other suitable restrictions on the client device **106**. The enforcement of the restrictions can be monitored and managed by the management service **121**. To this end, the multiple client devices **106** can be set up to abide by restrictions associated with the client device policy **175** concurrently. In some examples, an advanced mode of the process can involve the sound payload **132** including a specific user profile **133** and a unique device identifier **136** for a specific end-user. As a result, the client device **106** can be automatically enrolled with the management service **121**

for the specific user profile **133**, which is for an end user instead of a staged user profile **142** associated with an administrative user.

Referring next to FIG. **2**, shown is an example of a sequence diagram illustrating functionality implemented by components of the networked environment **100** in FIG. **1**. Beginning at step **203**, the management service **121** can receive a configuration profile **130** from an administrative device **112** or any other device. The configuration profile **130** can include data related to the enrollment and/or configuration of one or more client devices **106** with the management service **121**.

At step **206**, the management service **121** can generate the sound payload **132** based on the configuration profile **130**. In some examples, the management service **121** can encrypt a first portion of the configuration profile **130** data and omit encrypting a second portion of the configuration profile **130** data.

At step **209**, it is assumed the voice assistant service **115** can receive commands and provide responses through the voice assistant device **109**. The administrative user can invoke the voice assistant service **115** by uttering particular keywords associated with the voice assistant service **115** to the voice assistant device **109**, such as a smart speaker. Through a session with the voice assistant service **115**, the administrative user can provide additional commands to the voice assistance service **115** in order to invoke the management speech service **124**. In some examples, the management speech service **124** can be viewed as a voice-driven application or skill executed through the voice assistant service **115**.

At step **213**, the administrative user can utter a verbal command to enroll client devices **106** to an organizational group. For example, the verbal command spoken by the administrative user can include "Assistant, enroll client device to organizational group alpha beta." The expression "enroll client device" can represent predefined keywords associated with a command. The expression "organizational group alpha beta" can represent data that can be used to identify a particular sound payload **132** associated with the "alpha beta" organizational group. The request data can be transmitted to the management service **121**.

At step **216**, it can be assumed the management component **160** has been installed on the client device **106**. The administrative user can set the management component **160** in sound enrollment mode in preparation for recording a sound payload **132**. At step **219**, the management service **121** can transmit the sound payload **132** to the voice assistance service **115**. At step **223**, the voice assistant service **115** can broadcast the sound payload **132** to the client device **106** within an audible distance through the voice assistant device **109**. In some examples, the voice assistant device **109** has a display. The sound payload **132** can be broadcast during the playback of a video on the display of the voice assistant device **109**.

At step **226**, the management component **160** can extract data from the sound payload **132**. From the extracted data, the management component **160** can identify a server URL associated with the management service **121**. In this non-limiting example, it assumed the sound payload **132** includes encrypted data **148**, which was encrypted with a private key by the management service **121**. At this stage, the management component **160** may not be able to access the encrypted data **148**. The management component **160** can transmit a request to the management service **121** using the extracted URL from the sound payload **132**.

At step **229**, the management service **121** can transmit a public key over the network **118** to the management component **160**. At step **232**, the management component **160** can decrypt the encrypted data **148** using the public key received from the management service **121**. From decrypting the encrypted data **148**, the management component **160** can access data such as a device policy **139**, a staged user profile **142**, a staged user credential **145**, and other suitable configuration profile **130** data.

At step **235**, the management component **160** can use the data accessed from the extracted data **148** to proceed with the enrollment of the client device **106** with the management service **121**. At step **238**, the management component **160** can enforce a client device policy **175** to the operations of the client device **106**. The client device policy **175** can represent one or more device policies **139** that have been received from the management service **121**.

Moving on to FIG. **3**, shown is a flowchart depicting an example of the operation of a portion of the management service **121**. It is understood that the flowchart of FIG. **3** provides merely an example of the many different types of functional arrangements that can be employed to implement the portion of the management service **121** as described herein. As an alternative, the flowchart of FIG. **3** can be viewed as depicting an example of elements of a method implemented by the management service **121** in some implementations. Further, in some implementations, a portion or all of aspects of FIG. **3** can be performed by the management speech service **124**.

Beginning with step **301**, the management service **121** can receive a configuration profile **130** from an administrative user. The administrative user can use user interfaces for a management console **127** to manually specify configuration settings for a batch of one or more client devices **106**. In other cases, the administrative device **112** can transmit configuration data **154** stored in a file to the management service **121**. Whether manually entered or uploaded, the configuration data **154** can be stored as a configuration profile **130** in the data store **126**.

At step **304**, the management service **121** can encrypt portions of the configuration profile **130**, such as organizational group data **149**, a staged user profile **142**, a staged user credential **145**, and other suitable data associated with the sound payload **132**. In some examples, a unique public-private key pair can be generated for a particular sound payload **132**, which can be stored as encryption key data **135**. Portions of the configuration profile **130** can be encrypted with a private key. Additionally, a portion of the configuration profile **130** can be omitted from encryption, such as a server identifier or an internet protocol address of a server.

At step **307**, the management service **121** can generate the sound payload **132** by embedding the configuration profile **130** data in a sound wave signal. In some examples, the configuration profile **130** can be embedded as encrypted data **148** and non-encrypted data **151** onto the sound wave signal. In some implementations, the embedded configuration profile **130** data can be imperceptible to humans during playback of the sound payload **132**. In other implementations, the sound payload **132** can include a perceptible sound to indicate to humans that the playback of the sound payload **132** has begun, in progress, has been completed, or some other suitable progress indicator. In another example, the sound payload **132** can be embedded in a video file.

At step **310**, the management service **121** can receive a request for the sound payload **132** from the voice assistant service **115**. In other example scenarios, the request can be

received from the voice assistant service **115** by way of the management speech service **124**. The request can include the organizational group data **149**, such as an organizational group identifier. The organizational group data **149** can be associated with a particular client device **106**. Further, a particular sound payload **132** can be used based on the organizational group data **149**.

At step **313**, the management service **121** can transmit the sound payload **132** to the voice assistant service **115**. In some examples, the sound payload **132** can be transmitted by way of the management speech service **124**. Upon receiving the sound payload **132**, the voice assistant service **115** can transmit the sound payload to the voice assistant device **109** for broadcast. After being broadcast to nearby client devices **106**, the client devices **106** can record the sound payload **132** and extract data from the sound payload **132**. In some examples, the client device **106** can extract a URL server associated with management service **121** from non-encrypted data **151** in the sound payload **132**. In some scenarios, the voice assistant device **109**, the voice assistant service **115**, and/or the management service **121** can receive a request from a client device **106** to replay the sound payload **132** in the event that the client device **106** was not able to detect or record the sound payload **132**.

At step **316**, the management service **121** can receive a request for a decryption key from the client device **106**. In some examples, the request can include organizational group data **149**, such as an organizational group identifier. At step **319**, the management service **121** can transmit the decryption key to the client device **106**. In some examples, the management service **121** can transmit a public key to the client device **106**. The client device **106** can use the decryption key to decrypt the encrypted data **148**. The client device **106** can extract data from encrypted data **148** of the sound payload **132**, which can include the device policy **139**, the staged user profile **142**, the staged user credential **145**, the user profile **133**, the device identifier **136**, and other suitable managed device data. The client device **106** can use the extracted data to finish configuring that the device to be managed by the management service **121** according to a device policy **139**. Then, the management service **121** proceeds to the end.

Moving on to FIG. **4**, shown is a flowchart depicting an example of the operation of a portion of the management component **160**. It is understood that the flowchart of FIG. **4** provides merely an example of the many different types of functional arrangements that can be employed to implement the portion of the management component **160** as described herein. As an alternative, the flowchart of FIG. **4** can be viewed as depicting an example of elements of a method implemented by the management component **160** in some implementations. Further, in some implementations, a portion or all of aspects of FIG. **4** can be performed by other applications executed in the client device **106**.

Beginning with box **401**, the management component **160** can configure the client device **106** to operate in a sound enrollment mode. The client device **106** can be placed in the sound enrollment mode through different processes. In some examples, the management component **160** can render user interfaces that allow a user to select a user interface component that places the client device **106** in the sound enrollment mode. In other examples, the management component **160** can receive a verbal command from the voice assistant device **109**. For example, the voice assistant device **109** can utter the keywords, "Ok Client Device, open enterprise workspace app in sound enrollment mode," or any other keywords, that can cause the management component **160** to place the client device **106** in the sound enrollment mode.

In some examples, after the voice assistant device **109** has commanded the client device **106** to transition to the sound enrollment mode, the voice assistant device **109** can wait a predefined period of time before broadcasting the sound payload **132**. For example, after issuing the command to transmit to the sound enrollment mode, the voice assistant device **109** can wait five seconds initiating playback of the sound payload **132**. In some examples, the client device **106** can transmit an acknowledgement to the voice assistant device **109**, the voice assistant service **115**, the management speech service **124**, or the management service **121** to initiate the playback of the sound payload **132** or to acknowledge receipt of the sound payload **132**.

At step **404**, the management component **160** can receive the sound payload **132** and store it into the client data store **166**. The client device **106** can detect and record the sound payload **132** using its microphone **169**. In some examples, the playback of the sound payload **132** can include a human-perceptible portion such as "Ok client device, playback of the sound payload has begun." During or after the playback of the human-perceptible portion, an imperceptible portion can be played, in which the encrypted data **148** and/or the non-encrypted data **151** is transmitted.

At step **407**, the management component **160** can extract data from the sound payload **132**. In some examples, the sound payload **132** can include an encrypted data portion **148** and a non-encrypted data portion **151**. In these examples, the non-encrypted data portion **151** can include a server address for requesting a decryption key in order to access the contents of the encrypted data portion **148**.

At step **410**, the management component **160** can transmit a request for a decryption key to the management service **121** or the management speech service **124**. The request can be transmitted to the server address extracted from the non-encrypted data **151**. In some embodiments, the sound payload **132** may not have encrypted data **148**, and as a result, transmitting a request for a decryption key can be omitted.

At step **413**, the management component **160** can receive a decryption key from the management service **121**, which can be stored as encryption key data **135**. In some examples, the decryption key can be relayed to the client device **106** by way of a data connection between the voice assistant device **109** and the client device **106**. In some implementations, the decryption key transmitted is a public key that corresponds to the private key used to encrypt the encrypted data **148** for the sound payload **132**.

At step **416**, the management component **160** can decrypt the encrypted data **148** using the decryption key. The client device **106** can then access the staged user profile **142**, the staged user credential **145**, the device policy **139**, the user profile **133**, the device identifier **136**, and/or other configuration profile data **130** in order for the client device **106** to be managed by the management service **121**.

At step **419**, the management component **160** can determine whether the sound payload **132** has an advanced mode indicator. If not, the management component **160** proceeds to step **423**. At step **423**, the management component **160** can use the staged user profile **142** for the remainder of the configuration and/or enrollment process in order for the client device **106** to be managed by the management service **121**. The client device **106** can be enrolled to be managed by the management service **121** using the staged user profile **142** and the staged user credentials **145**. Then, the manage-

ment component **160** proceeds to the end. If the sound payload **132** does not have an advance mode indicator, then the management component **160** proceeds to step **426**.

At step **426**, the management component **160** can extract a first device identifier **136** from the sound payload **132**. In some examples, the first device identifier **136** can be accessed from the encrypted data **148** of the sound payload **132**. The first device identifier **136** can represent the serial number of a manufacturer, a unique identifier among devices managed by the management service **121**, or some other unique identifier. Then, the management component **160** can then determine whether the first device identifier **136** extracted from the sound payload **132** matches a second device identifier **136** stored in the client device **106**. If not, the management component **160** proceeds to the step **423**. If yes, the management component **160** proceeds to step **429**.

In some examples, the voice assistant device **109** can broadcast multiple sound payloads **132** during a playback session. Each sound payload **132** can have a different device identifier **136** and a different corresponding user profile **133**. Thus, during the playback session, each sound payload **132** can be used to configure a different client device **106**. Accordingly, each client device **106** can be configured to a unique user profile **133**.

At step **429**, the management component **160** can use the user profile **133** to proceed with the remainder of the enrollment. The sound payload **132** can include a mapping that indicates that the first device identifier **136** corresponds to a particular user profile **133**. The particular user profile **133** can correspond to a specific end-user. Thus, the management component **160** can proceed with configuring and/or enrolling the client device **106** with the management service **121** using the user profile **133**, which can include a specific user identifier. The management component **160** can begin enforcing the client device policy **175** for the operations of the client device **106**. Then, the management service **121** proceeds to the end.

The flowcharts and sequence diagrams of FIGS. **2-4** show examples of the functionality and operation of implementations of components described herein. The components described herein can include hardware, software, or a combination of hardware and software. If embodied in software, each element can represent a module of the code or a portion of the code that includes program instructions to implement the specified logical function(s). The program instructions can be embodied in the form of source code that includes human-readable statements written in a programming language or machine code that includes machine instructions recognizable by a suitable execution system, such as a processor in a computer system or other system. If embodied in hardware, each element can represent a circuit or a number of interconnected circuits that implement the specified logical function(s).

Although the sequence diagrams and flowcharts of FIGS. **2-4** show a specific order of execution, it is understood that the order of execution can differ from that which is shown. The order of execution of two or more elements can be switched relative to the order shown. Also, two or more elements shown in succession can be executed concurrently or with partial concurrence. Further, in some examples, one or more of the elements shown in the flowcharts can be skipped or omitted. In addition, any number of counters, state variables, warning semaphores, or messages could be added to the logical flow described herein, for purposes of enhanced utility, accounting, performance measurement, or troubleshooting aid. It is understood that all variations are within the scope of the present disclosure.

The components described herein, such as at least the computing environment **103**, the client device **106**, the administrative device **112**, the voice assistant device **109**, and the voice assistant service **115**, can each include at least one processing circuit. The processing circuit can include one or more processors and one or more storage devices that are coupled to a local interface. The local interface can include a data bus with an accompanying address/control bus or any other suitable bus structure. The one or more storage devices for a processing circuit can store data or components that are executable by the one or more processors of the processing circuit.

The components described herein can be embodied in the form of hardware, as software components that are executable by hardware, or as a combination of software and hardware. If embodied as hardware, the components described herein can be implemented as a circuit or state machine that employs any suitable hardware technology. This hardware technology can include one or more microprocessors, discrete logic circuits having logic gates for implementing various logic functions on an application of one or more data signals, application specific integrated circuits (ASICs) having appropriate logic gates, programmable logic devices (e.g., field-programmable gate arrays (FPGAs), and complex programmable logic devices (CPLDs)).

Also, one or more of the components described herein that include software or program instructions can be embodied in any non-transitory computer-readable medium for use by or in connection with an instruction execution system such as a processor in a computer system or other system. The computer-readable medium can contain, store, or maintain the software or program instructions for use by or in connection with the instruction execution system.

The computer-readable medium can include physical media, such as magnetic, optical, semiconductor, or other suitable media. Examples of a suitable computer-readable media include, but are not limited to, solid-state drives, magnetic drives, and flash memory. Further, any logic or component described herein can be implemented and structured in a variety of ways. One or more components described can be implemented as modules or components of a single application. Further, one or more components described herein can be executed in one computing device or by using multiple computing devices.

A number of software components are stored in the memory and executable by a processor. In this respect, the term "executable" means a program file that is in a form that can ultimately be run by the processor. Examples of executable programs can be, for example, a compiled program that can be translated into machine code in a format that can be loaded into a random access portion of one or more of the memory devices and run by the processor, code that can be expressed in a format such as object code that is capable of being loaded into a random access portion of the one or more memory devices and executed by the processor, or code that can be interpreted by another executable program to generate instructions in a random access portion of the memory devices to be executed by the processor. An executable program can be stored in any portion or component of the memory devices including, for example, random access memory (RAM), read-only memory (ROM), hard drive, solid-state drive, USB flash drive, memory card, optical disc such as compact disc (CD) or digital versatile disc (DVD), floppy disk, magnetic tape, or other memory components.

Memory can include both volatile and nonvolatile memory and data storage components. Also, a processor can

represent multiple processors and/or multiple processor cores, and the one or more memory devices can represent multiple memories that operate in parallel processing circuits, respectively. Memory devices can also represent a combination of various types of storage devices, such as RAM, mass storage devices, flash memory, or hard disk storage. In this case, a local interface can be an appropriate network that facilitates communication between any two of the multiple processors or between any processor and any of the memory devices. The local interface can include additional systems designed to coordinate this communication, including, for example, performing load balancing. The processor can be of electrical or of some other available construction.

Also, any logic or application described that includes software or code can be embodied in any non-transitory computer-readable medium for use by or in connection with an instruction execution system such as a processor in a computer system or other system. In this sense, the logic can include, for example, statements including instructions and declarations that can be fetched from the computer-readable medium and executed by the instruction execution system. In the context of the present disclosure, a "computer-readable medium" can be any medium that can contain, store, or maintain the logic or application described for use by or in connection with the instruction execution system.

It is emphasized that the above-described examples of the present disclosure are merely examples of implementations to set forth a clear understanding of the principles of the disclosure. Many variations and modifications can be made to the above-described examples without departing substantially from the spirit and principles of the disclosure. All modifications and variations are intended to be included herein within the scope of this disclosure.

The invention claimed is:

1. A system, comprising:

at least one computing device; and

program instructions executable in the at least one computing device that, when executed by the at least one computing device, cause the at least one computing device to:

receive a configuration profile for configuring a client device, the configuration profile comprising a device policy associated with an organizational group identifier;

generate a sound payload based on embedding the configuration profile into a sound signal;

receive a request from a voice assistant service for configuring the client device according to the device policy, the request comprising the organizational group identifier;

select the sound payload for initiating an enrollment process with a management service based on the request comprising the organizational group identifier; and

transmit the sound payload to the voice assistant service for broadcasting from a speaker device, wherein the sound payload is broadcast to the client device, and the broadcast of the sound payload initiates the enrollment process for the management service to manage the client device based on the device policy.

2. The system of claim **1**, wherein the sound payload comprises an encrypted portion and a non-encrypted portion, wherein the non-encrypted portion comprises a uniform resource locator (URL) associated with the at least one computing device.

3. The system of claim **2**, further comprising program instructions executable in the at least one computing device that, when executed, further cause the at least one computing device to:

generate the encrypted portion of the configuration profile, wherein the encrypted portion comprises at least one of a staging user identifier and a staging user credential.

4. The system of claim **2**, further comprising program instructions executable in the at least one computing device that, when executed, further cause the at least one computing device to:

receive a device request from the client device by way of the URL; and

transmit an encryption key to the client device for decrypting the encrypted portion of the configuration profile from the sound payload.

5. The system of claim **1**, wherein the device policy imposes an operational restriction on the client device.

6. The system of claim **1**, wherein the configuration profile comprises a first device identifier and a user identifier.

7. The system of claim **1**, wherein the sound payload is generated using a steganography process, and the sound payload comprises a human-imperceptible portion and a human-perceptible portion.

8. A non-transitory computer-readable medium embodying program instructions executable in at least one computing device that, when executed by the at least one computing device, cause the at least one computing device to:

receive a configuration profile for configuring a client device, the configuration profile comprising a device policy associated with an organizational group identifier;

generate a sound payload based on embedding the configuration profile into a sound signal;

receive a request from a voice assistant service for configuring the client device according to the device policy, the request comprising the organizational group identifier;

select the sound payload for initiating an enrollment process with a management service based on the request comprising the organizational group identifier; and

transmit the sound payload to the voice assistant service for broadcasting from a speaker device, wherein the sound payload is broadcast to the client device, and the broadcast of the sound payload initiates the enrollment process for the management service to manage the client device based on the device policy.

9. The non-transitory computer-readable medium of claim **8**, wherein the sound payload comprises an encrypted portion and a non-encrypted portion, wherein the non-encrypted portion comprises a uniform resource locator (URL) associated with the at least one computing device.

10. The non-transitory computer-readable medium of claim **9**, wherein the program instructions, when executed, further cause the at least one computing device to:

generate the encrypted portion of the configuration profile, wherein the encrypted portion comprises at least one of a staging user identifier and a staging user credential.

11. The non-transitory computer-readable medium of claim **9**, wherein the program instructions, when executed, further cause the at least one computing device to:

receive a device request from the client device by way of the URL; and

transmit an encryption key to the client device for decrypting the encrypted portion of the configuration profile.

12. The non-transitory computer-readable medium of claim **8**, wherein the device policy imposes an operational restriction on the client device.

13. The non-transitory computer-readable medium of claim **8**, wherein the configuration profile comprises a first device identifier and a user identifier.

14. The non-transitory computer-readable medium of claim **8**, wherein the sound payload is generated using a steganography process, and the sound payload comprises a human-imperceptible portion and a human-perceptible portion.

15. A computer-implemented method, comprising:

receiving, by at least one computing device, a configuration profile for configuring a client device, the configuration profile comprising a device policy associated with an organizational group identifier;

generating, by the at least one computing device, a sound payload based on embedding the configuration profile into a sound signal;

receiving, by the at least one computing device, a request from a voice assistant service for configuring the client device according to the device policy, the request comprising the organizational group identifier;

selecting, by the at least one computing device, the sound payload for initiating an enrollment process with a management service based on the request comprising the organizational group identifier; and

transmitting, by the at least one computing device, the sound payload to the voice assistant service for broadcasting from a speaker device, wherein the sound payload is broadcast to the client device, and the broadcast of the sound payload initiates the enrollment process for the management service to manage the client device based on the device policy.

16. The computer-implemented method of claim **15**, wherein the sound payload comprises an encrypted portion and a non-encrypted portion, wherein the non-encrypted portion comprises a uniform resource locator (URL) associated with the at least one computing device.

17. The computer-implemented method of claim **16**, further comprising:

generating, by the at least one computing device, the encrypted portion of the configuration profile, wherein the encrypted portion comprises at least one a staging user identifier and a staging user credential.

18. The computer-implemented method of claim **16**, further comprising:

receiving, by the at least one computing device, a device request from the client device by way of the URL; and

transmitting, by the at least one computing device, an encryption key to the client device for decrypting the encrypted portion of the configuration profile from the sound payload.

19. The computer-implemented method of claim **15**, wherein the device policy imposes an operational restriction on the client device.

20. The computer-implemented method of claim **15**, wherein the configuration profile comprises a first device identifier and a user identifier.

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